25X1A

[redacted]

APPLICATION OF COLOR TO IMAGE ENHANCEMENT

In the process of image enhancement, we seek to detect information which is recorded on a photograph, and, by suitable transformations, represent this information as a modified image in such a manner that the information is more perceptible to the human observer. The [redacted] Image Enhancement Instrument accomplishes this by a number of techniques, such as area scan filtering, frequency filtering, contrast enhancement, automatic contrast control, and line drawing representations. The instrument functions to produce a black and white image from a black and white input photographic transparancy.

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The criterion in enhancement is the production of a new image which better displays the information on the original photograph; this objective is not always synonymous with the faithful reproduction of the original scene which was photographed. Thus, a deliberate distortion (in the intensity sense, rather than the geometric shape sense), of the overall transfer characteristic between original scene and the ultimate display, is introduced in order to accomplish enhancement.

One very intriguing method of output display involves the use of color for presenting the enhanced image. This may be accomplished even though

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no color information is present at the input, i.e. the input photograph is black and white. The colors used in the output display do not necessarily represent the colors contained in the original scene; they are introduced in a synthetic manner, for the purpose of rendering more perceptible the original information. In this sense, the process seeks to exploit the color perceptiveness of the observer as a better means for "coupling" the information source (the original photograph) to the output device (the human observer).

25X1A Figure 1 shows a means for achieving this objective. At the left, portions of the [redacted] Image Enhancement Instrument are shown: an input transparancy is converted to a number of different electrical signals. These are combined in the Color Transformation Electronics Units into three component signals, which create, through the modulated lights source and scanner-camera-processor chain, three images, all black and white, but differing one from the other, which are projected simultaneously by the tri-color projector.

The criteria for the generation of the R,G, and B signals in the color transformation electronics, as well as the settings of the individual intensities of the three colors in the display projector, can be established by a program of study and experimentation. One possible transformation process is depicted in Figures II and III. In Figure II is shown a locus of colors, starting at A (blue) and proceeding along the arrows through a complete range of colors, ending at

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point W (white). The output display colors may be caused to progress along this locus in accordance with the amplitude of the picture signal from any one of the five outputs from the image enhancemant electronics, thus displaying the image in a complete range of colors, as opposed to shades of gray. The realizable colors within the line of spectral colors on the I.C.I. diagram may be traversed in any locus desired. The one shown is created by the transfer characteristic shown in Figure III, which shows individual outputs of the R.B, and G signals required to traverse the locus shown in Figure II. (Points are designated to correspond between the two figures). For example, point D is composed of half red and half greeen; it is therefore yellow in color. Point W, which is created for the brightest spots on the input image, is an equal mixture of the three colors, and is therefore white in appearance.

A locus may be traversed in response to signals other than input amplitude. For example, the outputs of the three channels of the enhancement instrument might be applied individually to the three channels, R,G, and B. In this manner, the fine detail on the picture will modulate the red, the medium detail green, and the coarse detail the blue color components in the output display.

The effect on the output display of these processes can best be established by a program of experimentation with actual images. It should be possible to achieve criteria for the design of a color enhancement insturment which, through exploitation of the color sensitivity of the human eye, greatly improves the perception of information which is recorded on a photograph.

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